# 1998–99 CATS ASSESSMENT
# Open-Response Item Scoring Worksheet

## Grade 7—Science

The **academic expectations** addressed by "Yolanda and James' Disagreement" are

2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.

2.3 Students identify and analyze systems and the ways their components work together or affect each other.

The **core content** assessed by this item includes

Content

- Organisms have basic needs. For example, animals need air, water, and food; plants require air, water, nutrients, and light. Organisms can survive only in environments in which their needs can be met.

Inquiry

- Designing and conducting scientific investigations.

**Yolanda and James' Disagreement**

Yolanda and James are having a disagreement. Yolanda thinks that natural rainwater is better for plant growth than water from the hose in her garden. James disagrees. He thinks that natural rainwater has too many chemicals from the atmosphere and that the hose water is better. They perform the following experiment to see whose prediction is correct.

- They buy two plants of the same species and size.
- They plant one outside and one inside away from the rain.
- When it rains, they water the inside plant with "hose water."

This experiment has several mistakes.

a. Identify **two** mistakes in the experiment's design.

b. Explain how you could redesign the experiment to settle Yolanda and James' disagreement.

# SCORING GUIDE
# Grade 7 Science

| Score | Description |
|---|---|
| 4 | The response is complete and shows a solid understanding of experimental design and the characteristics of a controlled experiment. Two mistakes in the experiment's design are correctly identified and there is a well-developed explanation of how the experiment could be redesigned to resolve Yolanda and James' disagreement. |
| 3 | The response shows an understanding of experimental design and the characteristics of a controlled experiment. Two mistakes in the experiment are identified and there is a reasonable explanation of how the experiment could be redesigned. The response may lack detail or contain minor errors or omissions. |
| 2 | The response shows a limited understanding of experimental design and the characteristics of a controlled experiment. At least one mistake in the experiment is identified and there is an explanation of how the experiment could be redesigned. The response may contain errors, misconceptions, and omissions. |
| 1 | The response is incomplete and shows a minimal understanding of experimental design and the characteristics of a controlled experiment. There may be an attempt to identify mistakes in the experiment and/or explain how to redesign the experiment, but the response has major errors, misconceptions, and omissions. |
| 0 | Response is totally incorrect or irrelevant. |
| Blank | No response. |

**Science Behind the Question:**

In a well-designed experiment all of the variables, except the one being tested, are held constant. In this case, the two variables that are constant are that the plants are the same species and size. Because of individual variation it would be better to use more than one plant in each test group. Variables that have not been controlled in the experiment include: amount of water, temperature, amount of light, humidity, and soil. The experiment could be redesigned to place several plants in the same soil, light, humidity, temperature. The volume of water used could be measured and only the type of water given to the plants could be varied. Rain water could be collected in a container and used to water one group of plants inside, though this would introduce new variables (the container and the time the water is in it before it reaches the plant). The plants could be placed outside with some under a shelter, but this would vary the sunlight.

# ANNOTATED STUDENT RESPONSE
# Grade 7 Science

## Sample 4-Point Response of Student Work

### Student Response

Two of the mistakes that James and Yolanda made in their experiment were: the amount of water they gave to each plant wasn't equal for both (they didn't measure) and one plant can't be inside when the other is outside (because of shade, clouds, etc.).

Now to do the experiment right and get accurate results they would need to:

1) Put both plants inside in the same window side by side.

2) Gather an exact amount of rain water.

3) Gather an exact amount of "hose water" equal to the amount of rain water.

4) Water both plants at the same time (one with rain water and one with hose water), using the same amount of water for both plants.

← Student correctly identifies two mistakes in the experiment's design (i.e., the water given to each plant wasn't equal and some plants were inside while others were outside).

← Student provides a well-developed explanation of how the experiment could be redesigned. The explanation addresses both mistakes identified.

Overall, the response demonstrates a solid understanding of experimental design and the characteristics of a controlled experiment.

# ANNOTATED STUDENT RESPONSE
# Grade 7 Science

## Sample 4-Point Response of Student Work

### Student Response

To settle this argument Yolanda and James need to prove which type of water is better, rain water or hose water.

They made three mistakes. First, they used only 2 plants. They need several subjects because if they use just one, each one might die or get sick. Second, they put one plant inside and one outside so they did not get the same amount of sunlight. Third, they don't know how much water Yolanda's plant got, so James's plant may have gotten more.

I have a suggestion for their experiment.

-First, build a small green house with 8 plants, 4 for Yolanda and 4 for James.

-Then take 3 measuring cups and set them outside to collect rain. Make sure all three measuring cups have the same amount of rain, then water the plants and water James' plants with the same amount of hose water.

-From here all they need to do is record their results.

← The student correctly identifies three mistakes in the experiment's design (i.e., used only two plants, kept some plants inside and some outside which varied the sunlight, and may have given James's plants more water than Yolanda's). Only two mistakes are required.

← Student provides a well-developed explanation of how the experiment could be redesigned. The explanation addresses all three mistakes identified.

Overall, the response demonstrates a solid understanding of experimental design and the characteristics of a controlled experiment.

# ANNOTATED STUDENT RESPONSE
# Grade 7 Science

## Sample 3-Point Response of Student Work

### Student Response

Yolanda and James are testing too many variables. They should have planted both plants outside, but put some kind of shelter from the rain over one. Inside the house could have a different climate than outside. Also in my point of view, the water amount is not being controlled. The rain might be giving the plant outside more water than the plant inside getting hose water.

If I was doing the experiment, I would by two plants of the same species and size just as Yolanda and James did. I would plant both plants outside, although, I would protect one of them from the rain. The water amount would be controlled because I would gently water the sheltered plant with hose water the same amount of time that it was raining.

← Student correctly identifies two mistakes in the design's experiment (i.e., the plants are in different climates and the amount of water given to the plants is not being controlled).

← Student provides a reasonable explanation of how the experiment could be redesigned. The explanation addresses both mistakes identified, but lacks some detail.

Overall, the response demonstrates an understanding of experimental design and the characteristics of a controlled experiment.

## Sample 2-Point Response of Student Work

### Student Response

The two mistakes that are found is one, the inside plant isn't getting as much sunlight, and two, the tempatures are different.

A) Get two identicle plants.

B) Set them outside with a roof over one of them.

C). Water the one with the roof over it with the hose when it rains on the outside one.

This is how I would redo it.

← Student correctly identifies two mistakes in the experiment's design (i.e., differences in amount of sunlight and differences in temperature).

← Student explains how the experiment could be redesigned. The proposed design controls for temperature, but does not clearly control for the **amount** of water the plants receive.

Overall, the response demonstrates a limited understanding of experimental design and the characteristics of a controlled experiment.

# ANNOTATED STUDENT RESPONSE
# Grade 7 Science

## Sample 1-Point Response of Student Work

### Student Response

A. Two mistake that Yolanda and James have made are, the first mistake is that they should have said what kind of water they are using from the hose like if its got chemicals. You could tell why the hose water would be bad for the plant. Another mistake is tell why the rainwater would be bad for plant and what chemicals it would get from the atmosphere and what it would do to the plant.

B. If I could redesign Yolanda and James experiment I would buy two plants of the same species and size and plant one inside and one outside. I would make a chart saying if the rainwater would have chemicals from the atmosphere I would tell what they are and what they would do to the plant. Then I would tell why the hose water would be bad for the plant. Then when it rained I would use hose water on the plant inside and I would take info on what happens from time to time.

Student attempts to identify mistakes in the experiment's design, but focuses on analysis of the two water sources. This shows a misunderstanding of what Yolanda and James' experiment was designed to test.

Student attempts to explain how the experiment could be redesigned. The proposed design is essentially the same as the original design, except that potential water pollutants are to be identified. This incorrectly assumes that the effects of various chemicals in water on plant growth is known in advance, which was clearly not the focus of the experiment.

Overall, the response demonstrates a minimal understanding of experimental design and the characteristics of a controlled experiment.

# INSTRUCTIONAL STRATEGIES
## Grade 7 Science

The open-response item **"Yolanda and James' Disagreement"** was designed to assess students' ability to (1) understand the scientific question that is asked in a discussion, (2) find mistakes in a given experimental design, and (3) propose a revised experimental design that would answer the original question. The topic for the question related to the effects of different water sources on plant growth. The instructional strategies below present ideas for helping students explore and master these concepts and skills.

Discuss the following concepts and skills with students:

- What is a valid scientific question that can be answered by experimentation?
- What variables must be controlled to conduct an experiment related to plant growth?
- What quantitative methods are needed for experiments, especially experiments related to vague descriptions such as "better growth," "survival," or "healthy population?"

Have students work individually, in pairs, in small groups, and/or as a class to complete any or all of the following activities:

- Investigate factors that affect bean or pea plant growth. Formulate questions that can be investigated. Determine the best way to measure plant growth, which variable to manipulate, and which variables to hold constant. Establish control and experimental plant groups. Prepare charts/tables of plant growth as a function of time. Compile and discuss class results.
- Research methods for studying the effects of nutrition on animal growth. Find research reports related to nutrition and animal growth, and report to the class on experimental findings. In the reports, summarize experimental designs (e.g., control group, experimental group, number of trials, variables).
- Design an experiment to test a simple life science question. Critique each others' experimental designs with suggestions for how to improve the experiments.